Booster Down Time

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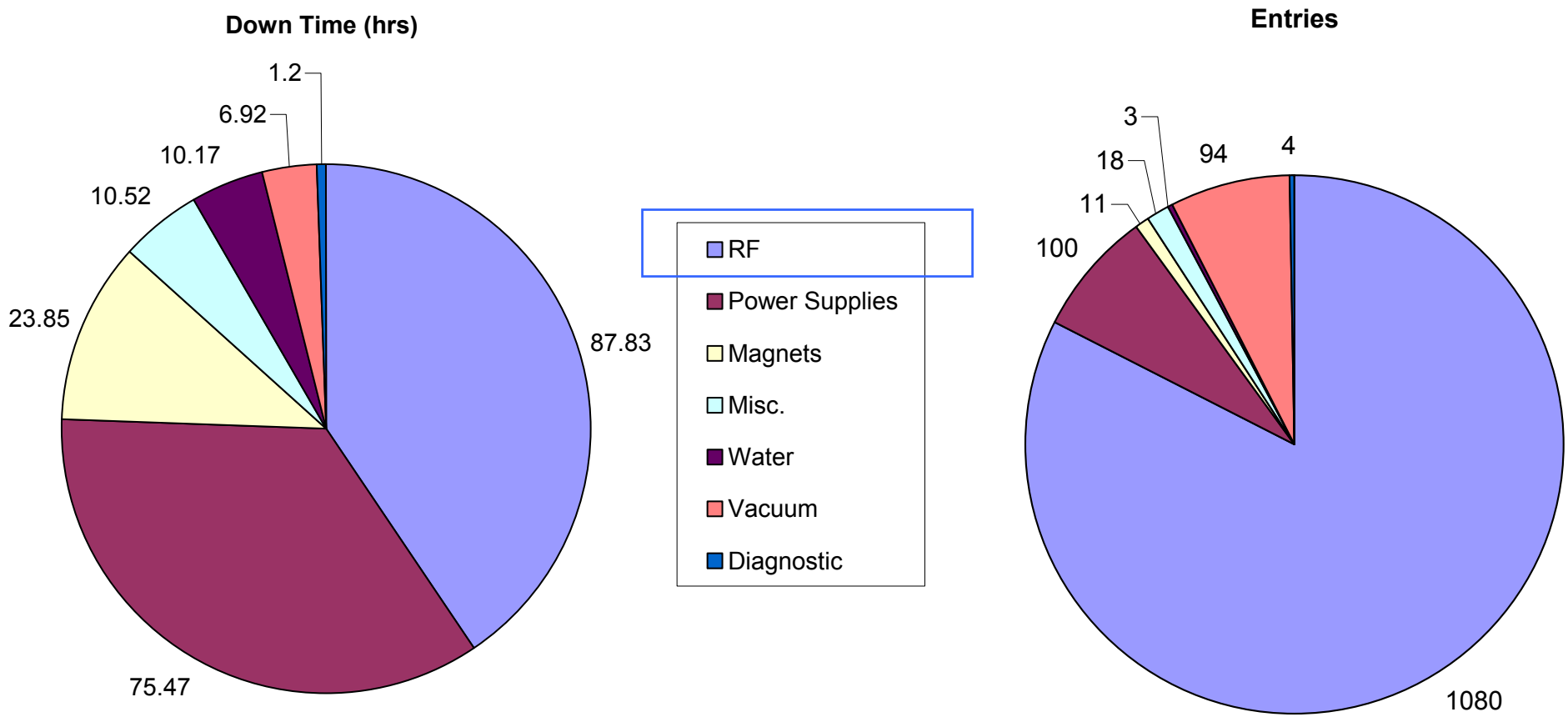
Logged Down Times

Downtime Summary
Sat Jan 1 00:00:00 2005 to Mon Aug 22 10:45:31 2005

System with 5 minutes or more of downtime	• 1905.63 hrs. of DT for Interval of 5601.76 hrs. • Downtime/Interval= 34.02 % •	Number & Details
TEVATRON ACCELERATOR SYSTEMS	• 444.77 hrs. • 23.34% of total downtime (1905.63 hrs.) • 7.94% of Interval (5601.76 hrs.)	179 Examine
MAIN INJECTOR	• 429.07 hrs. • 22.52% of total downtime (1905.63 hrs.) • 7.66% of Interval (5601.76 hrs.)	423 Examine
ANTIPROTON SOURCE	• 331.72 hrs. • 17.41% of total downtime (1905.63 hrs.) • 5.92% of Interval (5601.76 hrs.)	169 Examine
OTHER SYSTEMS	• 251.25 hrs. • 13.18% of total downtime (1905.63 hrs.) • 4.49% of Interval (5601.76 hrs.)	572 Examine
BOOSTER ACCELERATOR	• 215.95 hrs. • 11.33% of total downtime (1905.63 hrs.) • 3.86% of Interval (5601.76 hrs.)	1307 Examine
PRE-ACC AND LINAC	• 123.08 hrs. • 6.46% of total downtime (1905.63 hrs.) • 2.20% of Interval (5601.76 hrs.)	822 Examine
FIXED TARGET	• 68.35 hrs. • 3.59% of total downtime (1905.63 hrs.) • 1.22% of Interval (5601.76 hrs.)	77 Examine
CONTROL SYSTEMS	• 31.90 hrs. • 1.67% of total downtime (1905.63 hrs.) • 0.57% of Interval (5601.76 hrs.)	34 Examine
RECYCLER	• 9.55 hrs. • 0.50% of total downtime (1905.63 hrs.) • 0.17% of Interval (5601.76 hrs.)	8 Examine

Most Entries, but total 3.9%

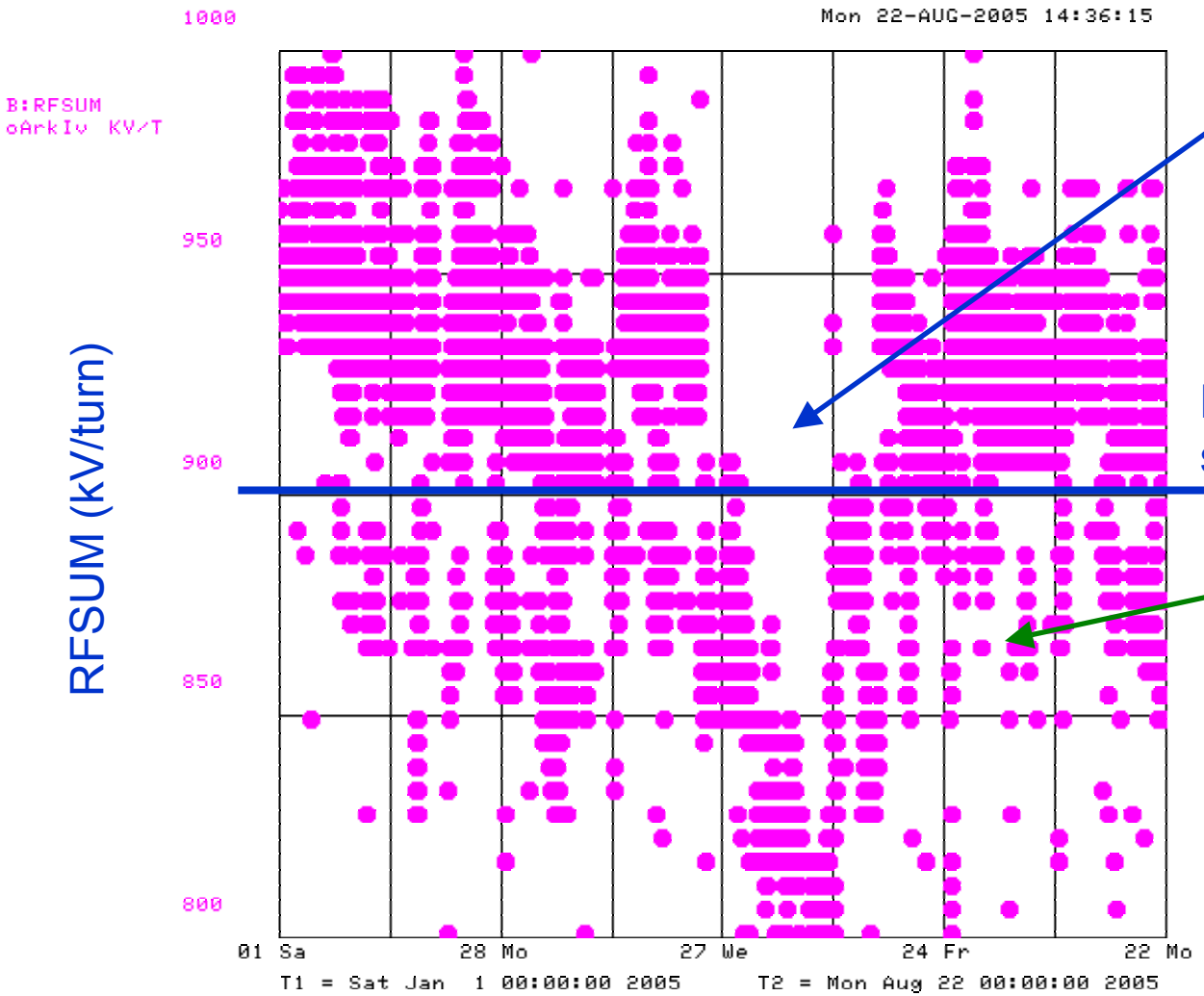
Booster Down Time Breakdown



Downtime Logger not Whole Story

- Counts only time failure brings program "down"
- Generally does *not* count access to repair problem
- Uptime to MiniBooNE since 2004 shutdown: 85%
  - Includes scheduled *and* unscheduled down time
  - Includes detector down time (small effect)
  - Up from FY04 (81%)
- Does not take into account *degraded performance* or recovery time.
  - In particular, need all 18 RF stations working for best slip stacking performance
  - Policy to date: "Run until performance totally unacceptable"

Degraded Performance



17/18 cavities: water leak

Minimum for slip stacking

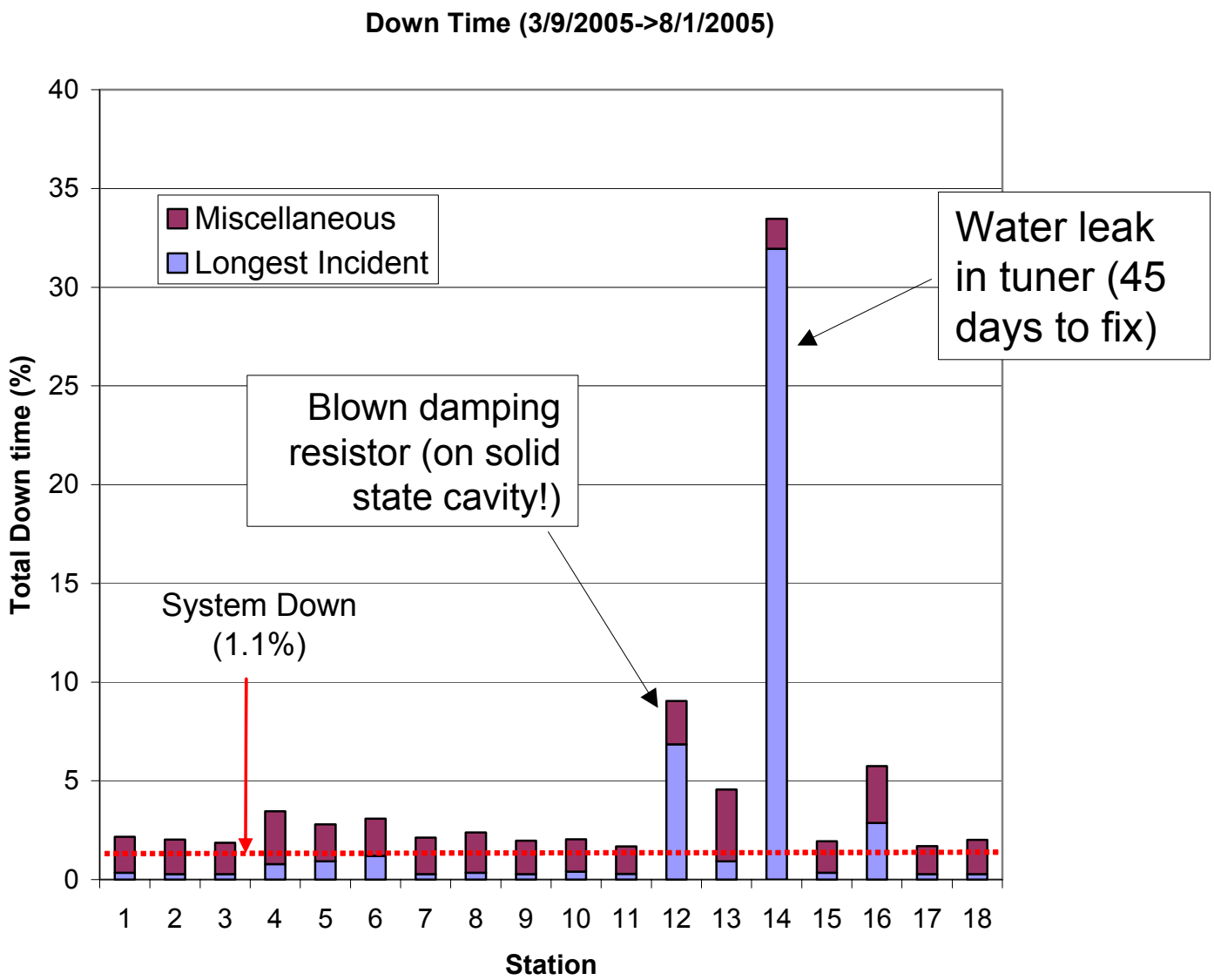
Misc. problems. Frequently dead or weak PA's

2005

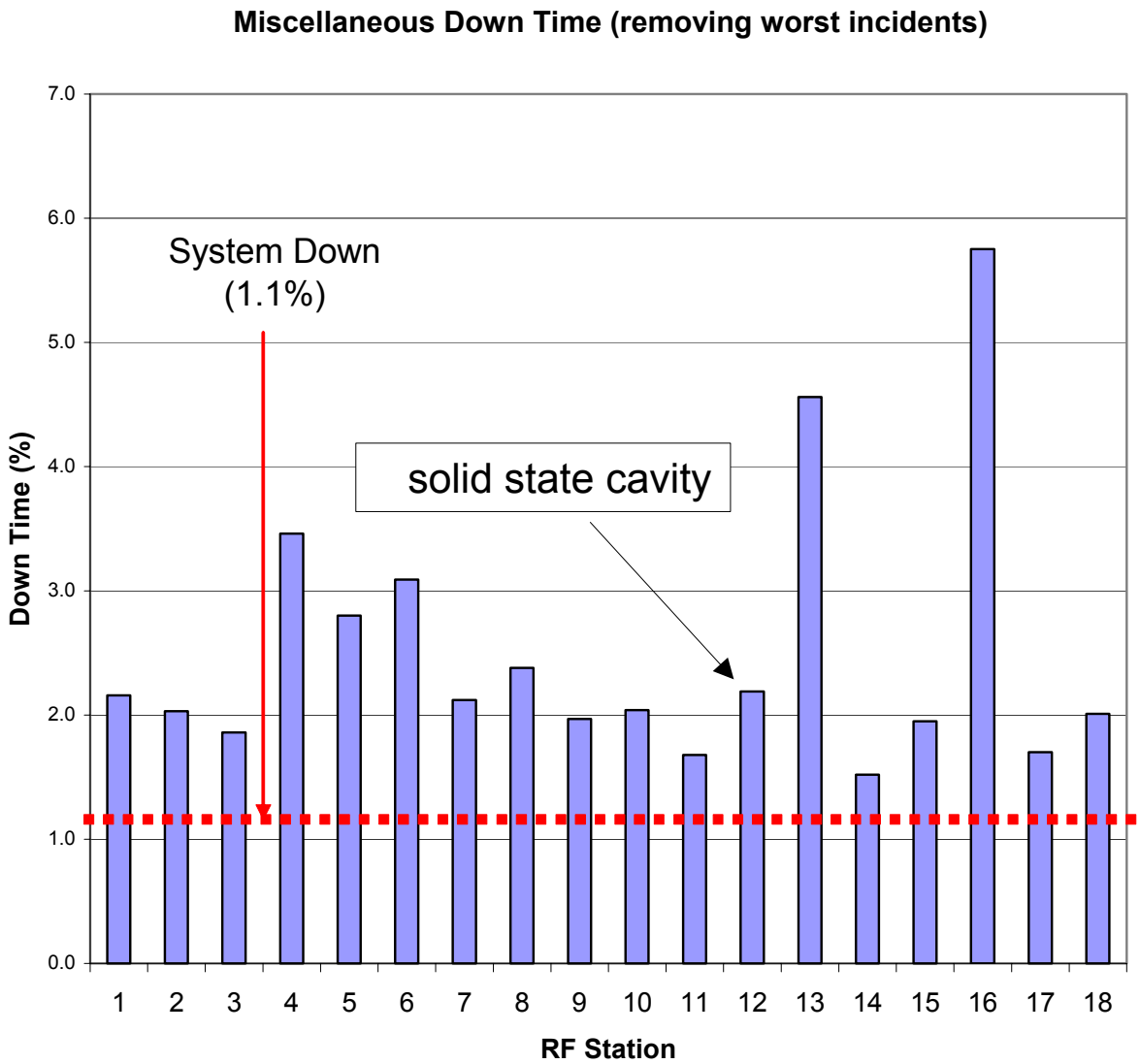
Proposed RF Power Amplifier (PA) upgrade

- Existing PA's original, 35 year old technology:
  - In-tunnel PA module contains 1 PA tube driven by 20 distributed amplifier tubes in a cascode configuration.
  - DA tube life limits lifetime to ~1 year -> must replace 1 ½ per month
  - $300-$400K/year to replace tubes
  - ~60 tech-hrs/PA for repair.
  - Driver cables old and some radiation damaged.
  - Modulators have reliability concerns.
  - RF techs typically receive ~100 mR/quarter
- Proposed solution:
  - Replace with solid state DA, as in Main Injector
  - Tunnel life goes from 1 yr -> 3 yrs
  - New cables
  - New, more reliable modulators
  - Already have one station operating in this mode (RF12)
  - EXPENSIVE! (~$7M)
  - Will not solve all of our problems

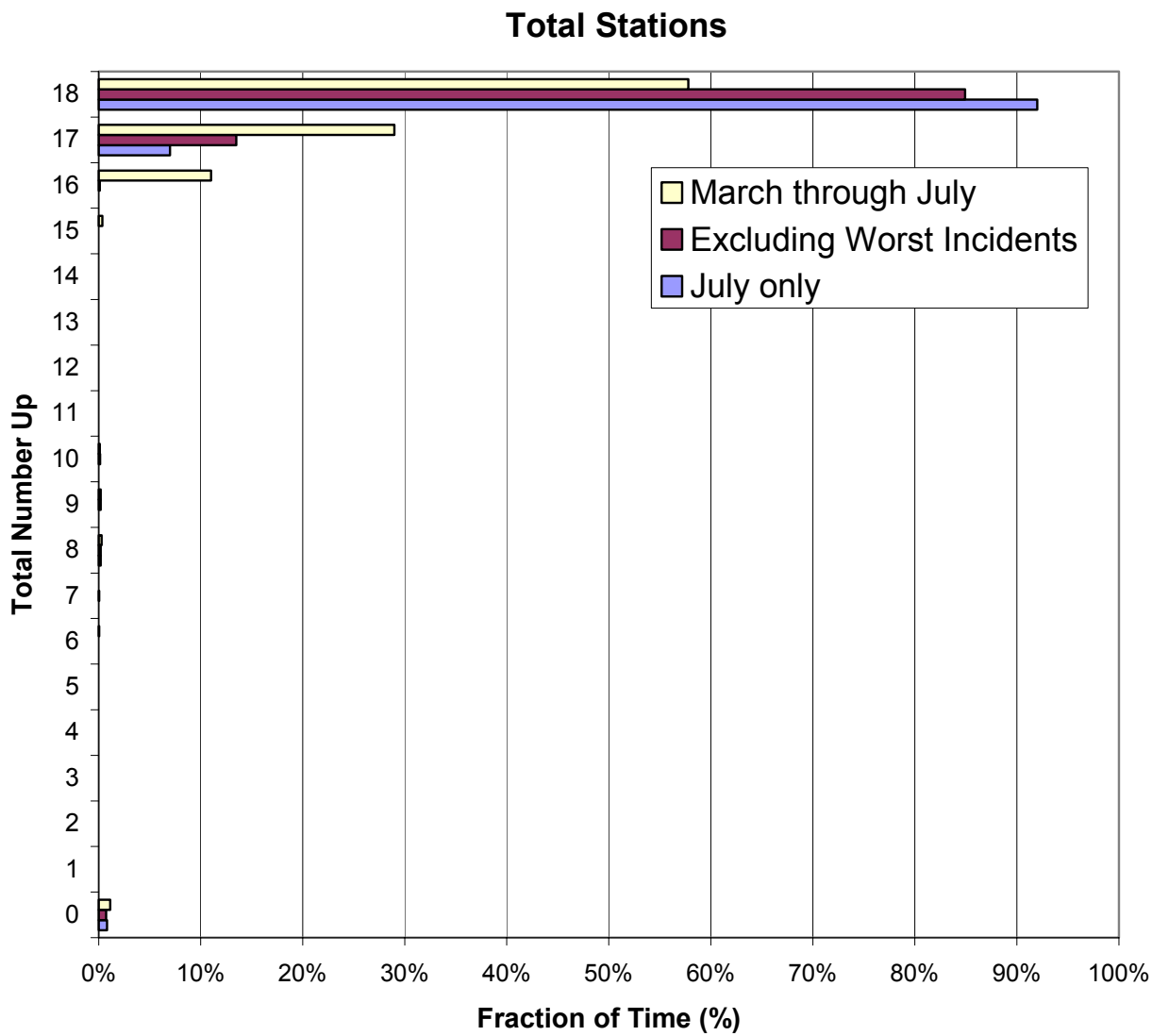
Down Time in 2005



Corrected Down Times



Available Stations



Typically have 18 stations ~85-90% of the time, outside of "catastrophic" incidents

Reasons for RF failures

- Things improved by PA upgrade:
  - PA failures
  - Cable failures
  - Modulator failures
- Other problems:
  - On-cavity damper resistors
  - On-cavity water leaks
  - On-cavity tuner arc problems
  - Anode supply problems
    - See Bob Ducar's talk
  - Bias supply problems
    - Rare, but limit rate

RF Plan

- Goal: Run with 18 cavities >95% of the time
- Near term:
  - Replace existing 19th prototype cavity with ordinary spare, driven by solid state PA
    - Will dramatically increase fraction of time with 18 stations
    - Will help evaluate relative performance of solid state PA's
  - Repair cavities as soon as they significantly degrade
    - Maximize time with >900 kV of gap envelope voltage
    - More accurately evaluate improvements of solid state drivers
      - ie, effect confounded by "run 'em into the ground" policy
  - Work with RF department to establish a reasonable preventive maintenance program
    - Eg, replace any old PA's whenever a tunnel access is made
- Longer term:
  - Evaluate benefit of solid state upgrade
  - Consider and compare other options
    - Modulator refurbishment
    - Cable replacement
    - 20th cavity
  - Hope to make a decision by 2006

Other Reliability Issues

- Power Supplies:
  - Low Voltage 400 MeV Line Power Supplies
    - Replacing unreliable "Power 10" series with newer supplies (handled through department, not plan)
  - Corrector supplies
    - Not a large source of down time
    - Will ALL be replaced as part of corrector upgrade (~2007)
  - Kicker supplies
    - Investigating options
    - Not currently in plan

Conclusions

- Considering its age, the Booster has maintained remarkable reliability as the demands on it have increased.
- Booster RF remains our biggest reliability issue
  - Down time
  - Reduced performance
- In the short term, we can increase reliability
  - 19th cavity
  - Prompt repair of degraded PA's
- In the longer term, we are investigating other options